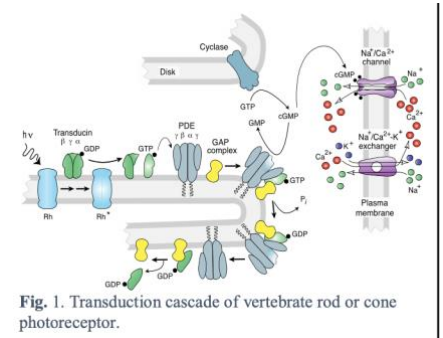




Analysis and modelling of adaptation and light response in cone photoreceptors

Background: Photoreceptors are the primary neurons underlying vision. The absorption of a photon or the binding of an odorant molecule initiates a G-protein coupled signal transduction cascade that leads to ion channel opening. This generates a transduction current that alters vesicular release at the synaptic terminal. While rod photoreceptors are responsible for night vision, cone photoreceptors sustain colorful daylight vision. Rods can reliably detect the absorption of single photon, however, they are saturated and non-functional at daylight. Cones are less sensitive to light than rods, but have the amazing ability to adapt to brightest light. While rods are well studied, much less is known about cones. In particular, it is still unclear how cones achieve such an amazing adaption range.



Aims: A recent technical advance in the laboratory of G. Fain and A Sampath at UCLA (USA) laboratory has made it possible to record with voltage clamp technique the light-dependent dynamics of the transduction current of wild-type and mutant mouse cones, providing an extensive library of unpublished data we propose to exploit to develop a cone model. We want to use our previously published rod model together with cone modeling and simulations to understand how differences in rod and cone responses have arisen as a synergetic effect from differences in their cell geometries and biochemical transduction pathways. The we want to use the model to study why cone photoreceptors can adapt to brightest light and avoid saturation, while rods become saturated already at moderate daylight.

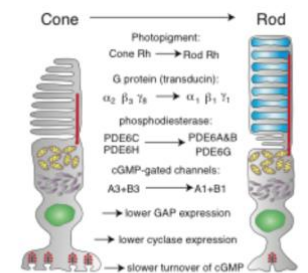


Fig. 4. Summary of molecular differences in transduction cascades of rods and cones.

Candidate: The candidate should be highly motivated and interested in neuroscience. He/she should have a background in physics, applied mathematics or computer science. She/he should also be familiar with computer simulations using C/Python or Matlab. The candidate should be passionate by her/his research. Students are encouraged to write a publication at the end of the period, and we encourage motivated student to continue on a PhD thesis.

Literature:

- Abtout et al, *Analysis of waveform and amplitude of mouse rod and cone flash responses*, J. Physiology (2021)
- Reingruber et al, *Detection of single photons by toad and mouse rods*, PNAS (2013)
- Fain and Sampath, *Light responses of mammalian cones*, Pflügers Archiv-European Journal of Physiology (2021)